

Digital Farming



Business Challenge: In the future all decisions of intelligent agribusinesses in farming will be data driven





Digital Farming brings decision support into enterprise farming and farmer collaboration processes









Efficient plan-to-harvest farming processes by providing executable recommendations towards farmers and farm managers leveraging structured and unstructured data from a variety of sources Definition of a flexible and standardized farming domain data and process model Supporting specific needs of different agribusiness segments Supporting different crops and crop categories as well as crop specific enhancements open for customers and partners

Help farmers thrive through Digital Farming – process example

Value driver:

- Support farming decisions along the entire farming cycle that define farming outcomes: yield, cost and environmental impact
- Ad-hoc reaction to natural events or diseases requires decision support based on real-time farming data from different sources
- Enables agribusinesses to digitize farming experience via decision support models that interact directly with farming processes



Main Segments in efficient and sustainable farming

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Large independent farms



- Farms are run like a large enterprise, including planning and costing
- Increasingly digitizing agricultural processes
- Managing complete agricultural processes



CPGs advising contract farmers



- Farms are run like a small business
- Increasingly looking for digital services from the CPG / Food Processing companies to which they supply



Farms are run like a small business

- Farmers are organized in cooperatives / associations
- Increasingly looking for digital services from the cooperatives / associations
- Cooperatives / associations are using digital services to increase customer loyalty

4 Ecosystem Partners / Farming Services Farm Equipment Logical Agri Chemicals I.e. sensor providers, weather station providers

All customer groups are looking for a future proof digital agriculture platform Requirements analysis in pilots and workgroup results confirm a high overlap of requirements for the 3 main segments

The intelligent enterprise: Digital Farming

Example: Fertilization Scenario

Showcase for industry standard cloud solution for Digital Farming

- Enabling decision support and efficient management of farming processes
- Looking at all phases of the farming cycle
- Highlighting possible integration points with Digital Core



Field and crop

planning

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Example: Argentine Cooperatives Association



Adding value for 50,000 farmers across Argentina Since 1922, the Asociación de Cooperativas Argentinas (ACA) C.L. has been demonstrating that farming in a cooperative manner delivers benefits for everyone involved. Building on core values of mutual aid, social responsibility, democracy, equality, equity, solidarity, honesty, and transparency, ACA has become a singular force in the Argentinian economy.

Today, the agricultural cooperatives that belong to ACA represent more than 50,000 producers who largely farm wheat, corn, soybeans, and sunflowers on more than 7 million hectares of land. ACA produces more than 17 million tons of grain each year and is the number one grain producer in Argentina. Its members' crops represent one-fifth of the agricultural output of the country.

Growth requires insight

Seven million hectares of farmland represents an area about half the size of the state of lowa, yet those hectares are spread across a country more than 18 times larger than lowa. The variations in every factor affecting crops – from sunshine to rainfall to pest problems – are considerable, and local conditions can change quickly. ACA wanted to help cooperatives develop sustainable approaches to farming, approaches promoting healthier crops, larger harvests, lower costs, and improved environmental stewardship. Its goal was to find a costeffective way to provide members with timely and relevant information about the factors that can affect their farms.



Decision Support – High Level Architecture Components

Integrated architecture consisting of Data Science Platform and Digital Farming allows to:

- Efficiently design, train, and test data science and machine learning models
- Once the models reach adequate maturity levels, they integrate directly results direct into business
 processes and bring them to business users.
- Record decisions, understand decision patterns





Farming Analytics and Reporting

Examples

In combination with SAP Analytics Cloud powerful real-time analytics and reporting for farming data can be achieved.

Adaptable and interactive dashboards giving farming decision makers a tailored view to key farming information.

Powerful filtering, slicing and dicing capabilities allow to report key figures based on field and farm attributes, geographical aspects and create ad-hoc reports.





Farm analytics can be integrated into a

Digital Boardroom for Agribusiness where information on farming KPIs can be brought together with data from across the company to produce a E2E view on company performance for management.

IoT Data Integration

- Similar to Machine Data Integration there is additional sensors and connected assets that can provide valuable data for farming. E.g.:
 - Weather stations
 - Soil sensors (moisture, PH, nutrition levels, resistance, EC)
 - Irrigation equipment
 - Water sensors (e.g. in canals)
 - Leaf/tree sensors
 - Drones
 - Remote cameras
 - Automated insect traps
- Digital Farming does not need to directly interact with these sensors but can consume the data through APIs or through the SAP IoT platform.



Leveraging additional functionality from the area of Spatial Data Processing in SAP HANA Spatial Services can enable and empower further use-cases for Digital Farming.

 Standard index values like NDVI (Normalized Difference Vegetation Index) for given area or field



Overlay of NDVI values for field



Calculation of min, max and average NDVI for a certain zone/area

 Identification of individual crops or crop patterns (e.g. sugar cane rows) from aerial imagery with Machine Learning

Example for Oil Palm



Automated detection of individual palm trees using machine learning, creation of "digital twins" for each tree and extraction of features (e.g. canopy size & color)

Example for Sugar Beet



Automated identification and counting of sugar beet crops



Machine Learning and Image Analysis Use-case: oil palm tree detection details

1. Train Neural Network



label palms manually on a subset of the imagea) blue points are centers of palmsb) red points are <u>not</u> center of palms

About 500 palm centers and 500 no palm centers have been selected

set patch size of algorithm approximately to the palm size

Next step: train neural network

training set: ~400 palms, ~400 no palms
test set: ~100 palms, ~100 no palms
retrain

2. Detect trees on image applying Neural Network



and apply the neural network



3. Result



4. Create or map palm tree entities in Digital Farming



Building custom aerial imagery indices and integration into Digital Farming

Example: NDWI (normalized difference water index)



Index modeler (definition of index calculation logic)



Resulting calculated NDWI data from sentinel satellite imagery

Labelling based image analysis using machine learning

1. Annotate Images and identify your own areas or objects of interest and label them

2. ML Model is trained based on created labels

3. ML Model is applied to detect areas that match labelled objects



Farmer Portals: Overview

- With SAP Cloud Platform it is possible to realize fully customized farmer portals to attract farmers, increase brand awareness and retention. The content can be edited online.
- Value adding collaborative business scenarios can be achieved by integrating cloud applications such as Digital Farming or even custom built applications directly into farmer portals.
- It is possible to share content relevant to the farmer like farming best practices, trainings, agronomy advice through the portal as text, images or videos.



Farming reference architecture

Modular reference architecture to support segment specific needs e.g.:



Digital Farming enables the implementation of longer-term strategies to build and incrementally enhance **decision support models for farming** as corporate assets leveraging **SAP Data Intelligence**. These models are the digital representation of the domain knowledge ("secret sauce").



In combination with SAP C/4HANA Digital Farming can serve as a basis to create a compelling E2E experience to farmers by integrating recommendations with web-shops and grower relationship management.



SAP Cloud Platform



Thank you!